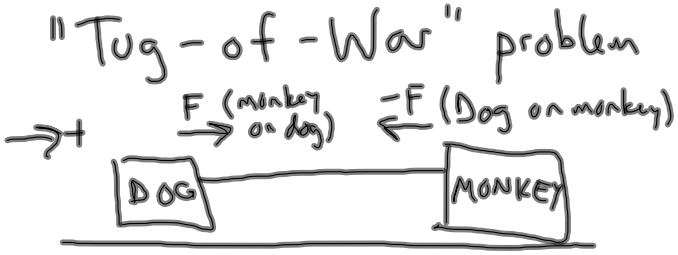
Quiz Thursday:

- FBDs
- Tug-of-War problems
- Net force problems
- 1-D motion (x- and y-directions)

A dog (14.0 kg) and a monkey (8.0 kg) are playing tug-of-war on a frictionless surface. They are attached by a rope, and the dog pulls on the monkey's collar with a force of 55.5 N.
a) What happens to the motion of each animal?
b) Which animal receives the most force?
c) Calculate the acceleration of the monkey.



a) Dog accelerates right (east)

Monkey accelerates left (west)

b) They receive the same force

- because they have different masses, the will accelerate at different rates

c) $\Sigma F = ma$ find monkey's acceleration

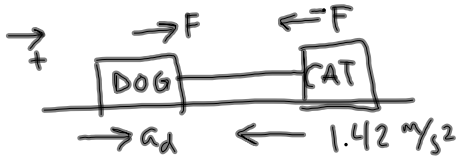
$$a = \frac{\Sigma F}{m}$$

$$= \frac{55.5\ N}{8\ kg}$$

$$= 6.94\ m/s^2$$

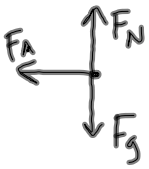
Friction Notes and Practice Problems 3.5.12 CP Physics

In a game of tug-o-war on a frictionless surface, a 120.0 N dog pulls on a 65.5 N cat, making the cat accelerate at 1.42 m/s/s. What is the acceleration of the dog?



FBD of Dog:

FBD of Cat:



What is accel. of dog?

- first find mass of the dog

$F_{gd} = 120\ N$

$F_{gd} = m_d a_g$

$m_d = \frac{F_{gd}}{a_g} = \frac{120\ N}{9.8\ m/s^2} = 12.24\ kg$

- find mass of cat

$F_{gc} = 65.5\ N$

$m_c = \frac{F_{gc}}{a_g} = \frac{65.5\ N}{9.8\ m/s^2} = 6.68\ kg$

- find force on cat

$\Sigma F = m_c a_c$

$= (6.68\ kg)(-1.42\ m/s^2)$

$= -9.5\ N$

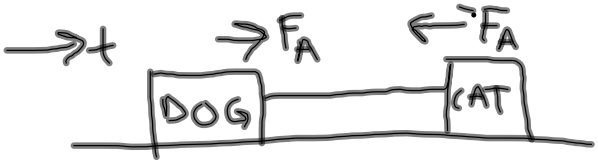
force between dog and cat

- finally, solve for dog's acceleration

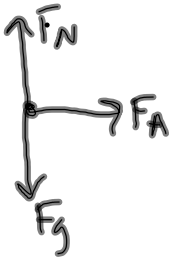
$\Sigma F = m_d a_d$

$a_d = \frac{\Sigma F}{m_d} = \frac{9.5\ N}{12.24\ kg} = 0.776\ m/s^2$

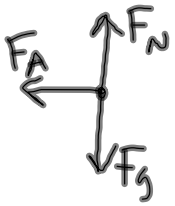
Dog ($m_d = 10$ kg) pulls on cat ($m_c = 5$ kg) with 25 N of force. Find acceleration of dog and cat. Draw FBD of both, also.



FBD dog:



FBD cat:



acceleration of dog

$$F_A = m_d a_d$$

$$a_d = \frac{F_A}{m_d} = \frac{25\,N}{10\,kg} = 2.5\,m/s^2$$

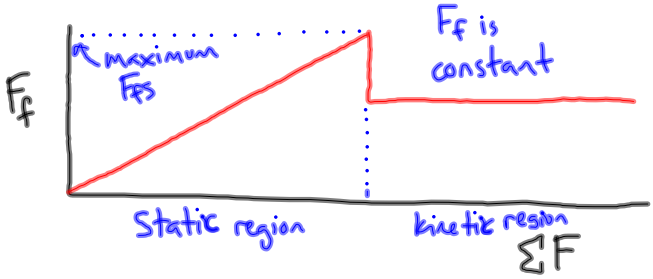
acceleration of cat

$$-F_A = m_c a_c$$

$$a_c = \frac{-F_A}{m_c} = \frac{-25\,N}{5\,kg} = -5\,m/s^2$$

Force of Friction:

- Types of friction:
  - Static → object NOT moving
  - Kinetic → object is moving



$$F_{fs} = \mu_s F_N$$

F_{fs} → force of static friction
μ_s → coefficient of static friction
F_N → normal force

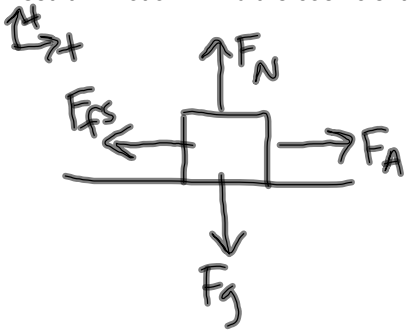
- coefficient of friction is dependent on object's shape and roughness

$$F_{fk} = \mu_k F_N$$

F_{fk} → force of kinetic friction
μ_k → coefficient of kinetic friction
F_N → normal force

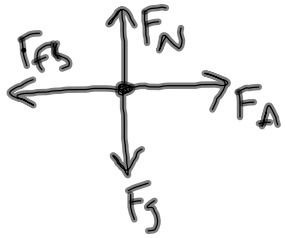
- Coefficient of static friction is always greater than coefficient of kinetic friction for same material

A 24 kg crate initially at rest on a horizontal floor requires a 75 N horizontal force to set it in motion. Find the coefficient of static friction between the crate and the floor.



* force of friction is always opposite of motion

FBD:



$F_{fs} = \mu_s F_N$

$\mu_s = \frac{F_{fs}}{F_N}$

$= \frac{75\ N}{235.2\ N}$

$= 0.31$

NO UNITS!

$\Sigma F_x = \emptyset$

$F_A - F_{fs} = \emptyset$

$F_{fs} = F_A = 75\ N$

$\Sigma F_y = \emptyset$

$F_N - F_g = \emptyset$

$F_N = F_g = mg$

$= (24\ kg)(9.8\ m/s^2)$

$= 235.2\ N$

A box with mass of 55 kg is being accelerated across a level floor with a force of 47 N. If the coefficient of friction between the box and floor is 0.37, what is the acceleration of the box?